

Lamprey River Baseline Fish Community Sampling Quality Assurance Project Plan

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A2 – Table of Contents

A2 – Table of Contents	2
List of Tables	2
List of Figures	3
A3 – Distribution List	4
A4 – Project/Task Organization.....	5
A5 – Problem Definition/Background	7
A6 – Project/Task Description.....	11
A7 – Quality Objectives and Criteria.....	14
A8 – Special Training/Certification.....	18
A9 – Documents and Records.....	18
B1 – Sampling Process Design	19
B2 – Sampling Methods.....	26
B3 – Sample Handling and Custody	30
B4 – Analytical Methods	30
B5 – Quality Control.....	30
B6 – Instrument/Equipment Testing, Inspection, Maintenance.....	32
B7 – Instrument/Equipment Calibration and Frequency	33
B8 – Inspection/Acceptance Requirements for Supplies and Consumables.....	34
B9 – Non-direct Measurements	34
B10 – Data Management.....	35
C1 – Assessments and Response Actions	36
C2 – Reports to Management.....	37
D1 – Data Review, Verification and Validation	37
D2 – Verification and Validation Procedures	37
D3 – Reconciliation with User Requirements.....	37
References.....	37

List of Appendices

Appendix A: Maps and Reconnaissance Notes
Appendix B: Field Standard Operating Protocols
Appendix C: Previous Lamprey Fish Sampling
Appendix D: Data Forms

List of Tables

Table 1 - QAPP Distribution List	4
Table 2 - NHDES VRAP 2002 Water Quality Data.....	9
Table 3 - Project Schedule Timeline.....	13
Table 4 - Sensor Specifications for YSI 650 MDS for Surface Water Samples.....	14
Table 5 - Measurement Performance Criteria for Surface Water Samples using Hand Held Meters	15
Table 6 - Surface Water Quality Field Measurements and Reference Limits	17

Table 7 - Project Quantification Limits	17
Table 8 - Data Collection Design.....	26
Table 9 - List of field analytical equipment required.....	30
Table 10 - Field Analytical QC Sample Table.....	31
Table 11 - Field Analytical Equipment Maintenance, Testing, and Inspection.....	32
Table 12 - Field analytical equipment calibration table.....	33
Table 13 - Non-Direct Measurements Criteria and Limitations Table	34
Table 14 - Sampling Team Field Sheet List	35

List of Figures

Figure 1 - Project organizational chart.....	5
Figure 2 - Lamprey Watershed Locus Map showing Designated Reach.....	7

A3 – Distribution List

Table 1 presents a list of people who will receive the approved QAPP, the QAPP revisions, and any amendments.

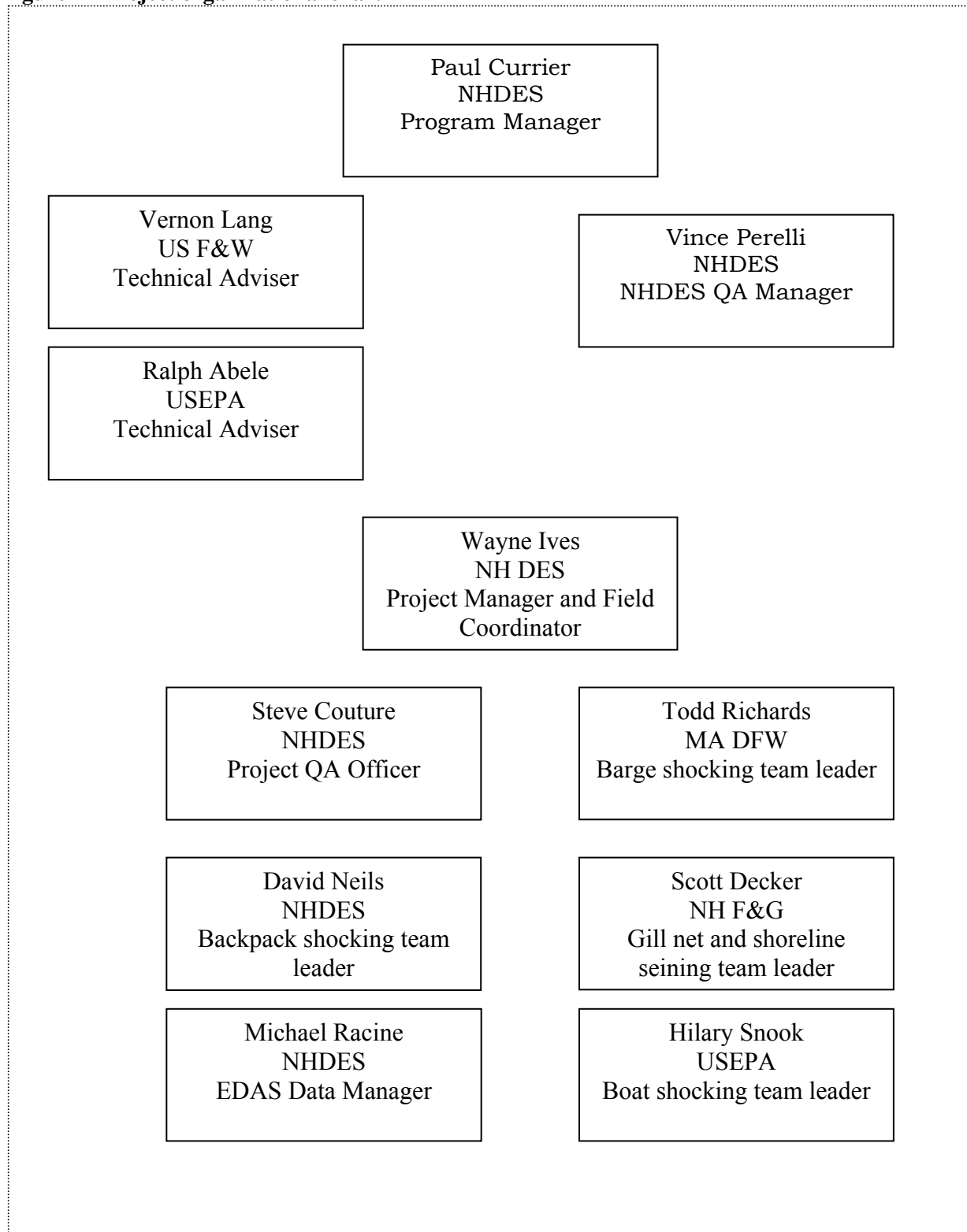
Table 1 - QAPP Distribution List

QAPP Recipient Name	Project Role	Organization	Telephone number and Email address
Wayne Ives	Project Manager and Field Coordinator	NHDES Watershed Management Bureau	603-271-3548 wives@des.state.nh.us
Steve Couture	Project QA Officer	NHDES, Watershed Management Bureau	603-271-8801 scouture@des.state.nh.us
Paul Currier	Program Administrator	NHDES Watershed Management Bureau	603-271-3289 pcurrier@des.state.nh.us
Ralph Abele	Technical Adviser	USEPA New England	617-918-1629 abele.ralph@epa.gov
Vern Lang	Technical Adviser	US F&WS	603-223-2541 ext 31 vernon_lang@fws.gov
Hilary Snook	Boat Shocking Team Leader	USEPA New England	781-860-4670 snook.hilary@epamail.epa.gov
David Neils	Backpack Shocking Team Leader	NHDES Watershed Management Bureau	603-271-8865 dneils@des.state.nh.us
Scott Decker	Gillnet and Seining Team Leader	NH F&G	603-271-2744 sdecker@wildlife.state.nh.us
Todd Richards	Barge Shocking Team Leader	MA F&W	508-792-7270 x 138 Todd.Richards@state.ma.us
Vincent Perelli	NHDES Quality Assurance Manager	NH DES Planning Unit	603-271-8989 vperelli@des.state.nh.us
TBD	USEPA Project Manager	USEPA New England	
TBD	USEPA Quality Assurance Officer	USEPA New England	

Based on EPA-NE Worksheet #3

A4 – Project/Task Organization

Figure 1 - Project organizational chart



Responsibilities

New Hampshire Department of Environmental Services (NHDES) will be responsible for organizational aspects of fieldwork, data management, QA/QC, and data reporting. The cooperating agencies will be responsible for one or more aspects of the field work including flow measurements, water quality parameters, habitat assessment, and fish capture, identification and enumeration as described below.

Wayne Ives of NHDES Watershed Management Bureau will be the Project Manager and Field Coordinator responsible for coordinating the field logistics, and data management and reporting for the project. He will be responsible for coordinating the sampling program, including decisions when conditions are or are not appropriate for sampling. The Project Manager will be the primary contact between NHDES and EPA for QAPP review. Steve Couture will be the quality assurance manager ensuring data quality objectives are met. Wayne and Steve report to Paul Currier, Administrator of the Watershed Management Bureau.

There will be four field teams for fish collection. All agencies will provide qualified staff to the best of their abilities. David Neils of NHDES Watershed Management Bureau will head the backpack shocking team. Todd Richards of Massachusetts Division of Fisheries and Wildlife (MA F&W) will head the barge shocking team. Hilary Snook will lead the boat shocking team. Scott Decker of NH F&G will lead the gill net and shoreline seining team. Each field team will carry out water quality measurement, flow measurement, and fisheries sampling according to the SOPs appropriate to their tasks.

Ralph Abele of USEPA and Vern Lang of US F&W will review and comment on the QAPP, and provide technical advice on field procedures and data analysis.

Quality and Logistical Responsibilities

Field team leaders will report data quality concerns and any necessary modifications to SOPs first to the Project Manager, who will record and provide this information in a QA report to the QA Officer. Team leaders will report logistical problems to the Project Manager. If problems arise in the field or in any phase of the study, the field team leaders will contact the Project Manager and he will determine the best course of action in consultation with the technical advisors and field team leaders.

Equipment Responsibilities

NHDES will be responsible for making available two backpack shockers, two flow meters, four sets of water quality parameter measuring kits and one Hydrolab. NH F&G will be responsible for making available up to 2 backpack shockers, a boat shocker and the available experimental gill nets. USEPA will be responsible for making available an electroshock boat, the seine nets and up to 4 backpack shockers. MA F&W will be responsible for making available a barge shocker and some of the experimental gill nets. NHDES will also be responsible for a boat(s) for the gillnet and seining team.

Database Responsibilities

The Project Manager and Project QA/QC Officer will review all field sheets for the project to see if the data meet the objectives for the project. Michael Racine of NHDES Watershed Management

Bureau, the EDAS Database Manager, is responsible for post-collection data quality control and data management. The EDAS Database Manager will enter all flow, fish, and water chemistry data into the EDAS database.

A5 – Problem Definition/Background

Project Definition

The purpose of the project is to collect a complete, representative sample of resident fish species for the Designated Reach of the Lamprey River (See map below). The Lamprey Designated Reach is in Lee and Durham, NH. Fish will be collected, counted by species, and released at a time and place so they are not collected and counted more than once. The number of fish collected for each species will be totaled for the entire study reach, and relative abundance for each species present will be computed to obtain a “baseline fish community.” Subsets of fish data of interest will also be assessed, such as sets above and below Wiswall Dam. The project will be considered a success if numbers of fish by species are obtained for the planned sampling locations. Additional information will be collected including dissolved oxygen, temperature, specific conductivity, turbidity, pH, flow, and habitat parameters. The purpose of the additional information is to help define river flow and water quality conditions at the time of fish collection.

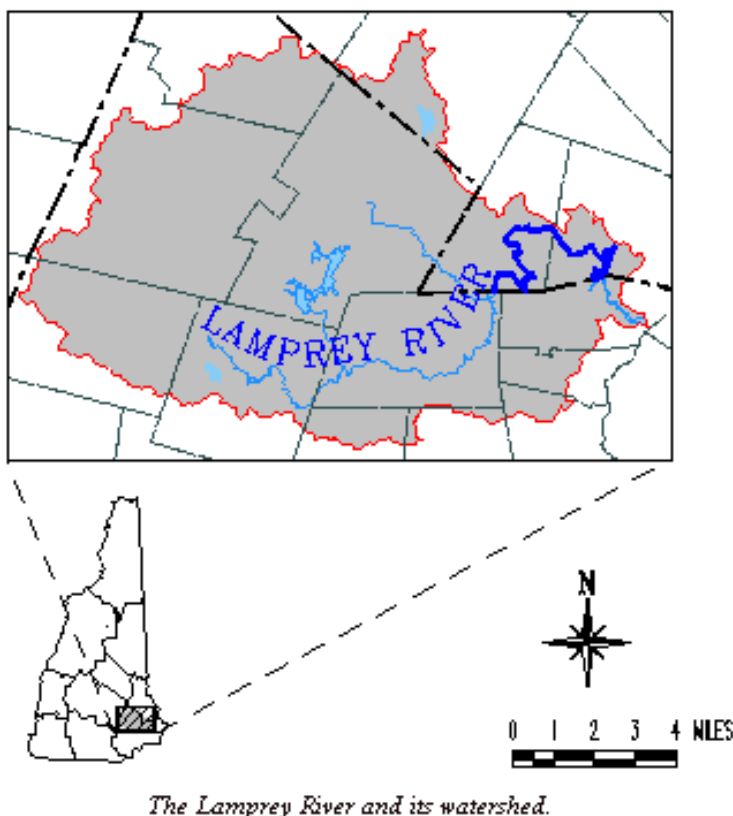


Figure 2 - Lamprey Watershed Locus Map showing Designated Reach (in bold blue)

Source: <http://www.des.state.nh.us/rivers/lamprey1.htm>

One use of the data will be to aid the Department of Environmental Services (DES) in developing criteria for determining Protected Instream Flows in the Lamprey Designated Reach. The sampling will identify existing fish species and relative abundances for the Designated Reach above and below Wiswall Dam.

Other uses of the data by any or all of the cooperating agencies may follow. For wadeable reaches, fish will be collected in accordance with protocols from the NHDES Biomonitoring program. For deep runs and deep impounded sections, fish will be collected using protocols from MA DFW adapted to this study. Collection results will be recorded for each station resulting in several data sets for each method. A station will represent one complete fish collection sample using any single method. Each sampling station will include flow measurements or reading from a reference location, water quality measurements, and station specific geomorphology and riparian conditions so that other researchers can use the data from any individual station or combine stations as they choose.

Background

The Lamprey River originates in Northwood, New Hampshire and flows 47 miles east to Great Bay. Part of the Lamprey River is designated for special protection in the Rivers Management and Protection Program (RSA 483). The Lamprey Designated Reach comprises approximately 13 miles running through the towns of Lee and Durham. The Designated Reach is a sixth order stream according to UNH assessment, which is available as GIS coverage at NHDES. River flow is regulated by a number of dams including dams controlling Mendums Pond and Pawtuckaway Lake. Wiswall Dam is important because it occurs within the Designated Reach and acts as a barrier to fish passage.

A USGS gage, identified as USGS 01073500 LAMPREY RIVER NEAR NEWMARKET, NH is above Packers Falls near the downstream end of the Designated Reach. See the detailed map in Appendix A. A USGS precipitation gage, identified as EXETER RIVER AT HAIGH ROAD, NEAR BRENTWOOD, NH is located in an adjacent watershed approximately 10 miles southwest of Designated Reach.

The Lamprey River watershed is in the NH seacoast area watershed. The Lamprey River Management Plan states, "The presence of and potential for additional runs of river herring, American shad, and Atlantic salmon make this the state's most significant river for all species of anadromous fish. Sunfish, catfish, perch, largemouth and smallmouth bass, and pickerel are common warmwater resident species, and coldwater residents include brown and brook trout," (<http://www.des.state.nh.us/rivers/plans/lampln13.htm>.) NH F&G stocks trout in the upper reaches and tributaries to the Lamprey River. A local fishing group stocks the river with trout below Wiswall Dam. The Macallen Dam in Newmarket, downstream of the Designated Reach, allows some limited fish passage by way of a fish ladder.

Previous fish sampling efforts on the Lamprey by NH F&G (1983-1985) have been focused on the stocks of trout and have been collected at five sites using mainly experimental gillnets and backpack shocking, with two instances of minnow traps. Previous fish sampling efforts by NHDES have been limited to nine wadeable portions of the river or its tributaries and have been collected on 150-meter reaches. (Appendix C includes results from previous studies.) This

distance is a rule of thumb usually applied by NHDES to fish sampling on first to fourth order streams. Some fisheries research suggests that longer reaches need to be sampled on medium and larger rivers to include similar ranges of habitat as would be found within a 150-meter reach on a small stream. Fish sampling of deeper riverine habitat found on larger rivers is rare in New Hampshire and may represent a gap in the assessment of the fishery that will be addressed by gillnets in this study. Sampling in this study will incorporate collection in deeper water environments and more frequent sampling intervals to simulate collection over longer reaches.

Water quality results for 2002 from the NHDES-sponsored Volunteer Rivers Assessment Program are shown in the table below. These results are from the approximate time of year that this project will occur in and within the project limits.

Table 2 - NHDES VRAP 2002 Water Quality Data

Site	Date	Time	DO mg/L	DO %sat	Water temp C	pH	Turb.	Cond.	Site	Town
9-Lmp	8/3/2002	8:20	6.25	75.4	24.9	7.1	1.2	207.5	Lee Hook Road	Lee
9-Lmp	8/19/2002	8:04	6.48	77.5	24.4	-	0.5	219.5	Lee Hook Road	Lee
9-Lmp	9/28/2002	8:39	6.96	71.6	16.7	6.79	0.75	252.7	Lee Hook Road	Lee
9-Lmp	10/19/2002	11:45	9.38	83.4	10	5.4	1.8	248.1	Lee Hook Road	Lee
8-Lmp	8/3/2002	8:05	6.27	77.6	26	7.1	1.6	201.5	Wiswall Road Bridge	Durham
8-Lmp	8/19/2002	7:24	6.78	84	26.1	-	1.51	211.4	Wiswall Road Bridge	Durham
8-Lmp	9/28/2002	8:20	6.8	72.6	18.5	6.51	2.08	234.4	Wiswall Road Bridge	Durham
8-Lmp	10/19/2002	11:30	9.31	83.4	10.6	5.6	2.04	221.4	Wiswall Road Bridge	Durham

Site Reconnaissance and Planning Meetings

There were three important planning events. On October 11, 2002, NHDES conducted a reconnaissance of the river between the Epping-Lee boundary and Packers Falls that covered most of the Lamprey Designated Reach. The flow on that day was between 4 and 5 cfs based on USGS provisional data from the Packers Falls gage. The annual Q98 is 11 cfs and the 7Q10 is 5.6 cfs according to Fennessey. Then on March 10, 2003 the cooperating agencies met to discuss the conceptual sampling plan at the Nashua Fish Hatchery. During the meeting gillnets and shoreline seines were added to the sampling methods. The intention to measure fish lengths was left to be determined by the availability of manpower at the time of sampling. The decision was made to collect fish in discrete sampling units rather than continuous sampling of wadeable and non-wadeable habitats. On June 25, 2003, another river reconnaissance was made to identify access and sampling locations.

The October 2002 reconnaissance was made to assess the feasibility of sampling the riverine sections (non-impounded) with backpack shockers or boat shockers, to define stream width for assessing required sample length, and to familiarize NHDES with the Designated Reach. At the time only the riverine reaches, not impounded reaches, were going to be addressed in order to get a riverine fish community. Also, there were no plans at the time to use a barge shocker or any netting techniques. Consideration of sampling reaches during the reconnaissance was stopped

below Packers Falls because the impoundment behind the Macallen Dam in Newmarket reaches upriver to a point just below Packers Falls. A large portion of the river behind Wiswall dam was also excluded initially from consideration because it is impounded. The purpose of the project has evolved to define the baseline fish community for the Designated Reach, so that the sampling teams will now sample in these impounded sections for this project. During the reconnaissance, NHDES observed and recorded stream widths and depths, substrate material and suitability for either backpack or boat electroshocking.

The October 2002 reconnaissance identified deep runs suitable for electroshocking with a boat and a lesser amount of shallow riffle/pool or run sequences suitable for electroshocking with backpack units. Bedrock exposures are present intermittently in the river. Depths of 2 feet and less were considered suitable for backpack shocking units, and depths greater than two feet were considered suitable for boat electroshocking. A little over two miles of the river were considered suitable for backpack shocking. Several sections of the river are not accessible to backpack shocking because of depth. The boat-shockable reaches are sometimes interrupted by cobble dams or bedrock outcrops, but there are almost 4 miles of non-impounded riverine macrohabitat in aggregate and almost another 4 miles in the two impounded reaches that appeared suitable by depth for boat shocking. Of the remaining length of approximately 13-mile Designated Reach, there are about 2.25 miles of segments varying rapidly from shallow to deep laterally and so was considered unsuitable for sampling by either backpack or boat shocking method. Some of these segments may be suitable for barge shocking. Access to the river is limited, especially boat trailer access, because of the low incidence of roads near the river and because of steep banks. The river was divided into the wadeable sections, boat shockable sections and sections where neither was feasible to distinguish the reaches that could be sampled with the methods planned at that time. Addition of gillnets and shoreline seines will expand the sampling coverage. Within the boat-shockable and some of the variable reaches, gillnets can be used to assess deep, mid-channel environment and shoreline seines can be used assess shallow shore margins. Combining of these sampling methods appears capable of assessing all the depth ranges present in the Lamprey Designated Reach.

The reconnaissance also noted that because the banks along most of the river were steep, the channel width will not vary appreciably with changes in flow. At some locations, like riffle zones over cobbles or bedrock, the stream widths at low flow were less than channel widths, but for the most part the stream width was very close to the channel width even with the low flow occurring on the day of the reconnaissance. Stream channel widths were measured with a laser range finder or estimated by the reconnaissance team at intervals for the Designated Reach down to Packers Falls. Recorded widths ranged from 30 feet to 150 feet, but were most frequently between 60 and 80 feet.

At the March 10 meeting, the gillnet and shoreline seining fish sampling methods were included and it was decided to reassess the areas previously considered marginal for sampling by boat or backpack methods for sampling by barge shocker.

On June 25, 2003, Wayne Ives and Dave Neils of NHDES met with Scott Decker of NH F&G and Todd Richards of Massachusetts Fish and Wildlife to canoe the river and select fish sampling locations for each method and access points on the Lamprey River. The assessment began at the

Designated Reach at the Lee town line and ended at Wiswall Dam. Agreement was reached on several access points for the boat shocker. Additional access points are needed below Wiswall Dam. Sampling methods were identified for several locations in the reconnoitered reach.

A6 – Project/Task Description

Work To Be Performed

Fish will be collected from the Lamprey Designated Reach during a 5-day sampling period to be conducted in late August or early September 2003. Scheduled collection dates are August 25-29, with contingency dates September 2-5. Fish will be collected above and below Wiswall Dam, which acts as a barrier to fish passage. An important objective of this effort is to sample different habitats proportionally to establish a baseline fish population. These habitats are shallow riffle/pool sequences that are less than 2 feet deep, intermediate zones composed of river segments with depths between 1- and 4-feet deep, and deep runs or impoundments that are two feet and more deep. The deep runs may have shallow margins. Several different collection methods will be used to capture fish from these different habitats. Each method will be applied at a number of stations on different parts of the Designated Reach suitable for their use. Backpack electroshockers will be used to sample the shallow reaches; barge electroshockers will be used to sample intermediate reaches; boat electroshockers will sample deep runs. Netting techniques will augment sampling in deep runs. Shoreline seining will be used to sample shallow margins of deep runs, while gillnets will sample the deeper central portions of deep runs. See Appendix A for a map of sample locations. The fish collected will be recorded by station and collection method. Information about the stream's physical and chemical parameters will also be collected to support the fish data. These data will identify flow and water chemistry conditions for each station.

Later analysis will use the fish collections to define the baseline fish species relative abundance for the Designated Reach of the Lamprey River above and below the dam. A Baseline Fish Community (BFC) will be developed subsequently and become part of the investigation used to support determination of the Protected Instream Flows for the thirteen-mile segment of the Lamprey River Designated Reach. Desired results include numbers and species of fish captured at each station, numbers and species by macrohabitat for the river as a whole, and for above and below Wiswall Dam. An aggregate of all fish captured will be used to identify the ten most frequently captured species and their relative abundance as a percent of the total population captured. Any other species will be combined and identified as 'Other' and their numbers represented as a cumulative percent.

Sampling tasks

Access reconnaissance will be conducted by the project manager to identify and map proposed access points to the river for the different sampling equipment and crews. The project manager will also identify, before the sampling event, one or more reference locations for streamflow measurements. One reference location will be upstream of Wiswall Dam. A staff gage was established by the town of Durham in 2002 downstream of Lee Hook Road. The gage is expected to be reestablished in 2003. It may be possible to measure flow using this gage during the project.

A reconnaissance meeting with the sampling team leaders was held June 25, 2003. At the meeting, the proposed access points to the river were assessed and approved by the sampling team leaders, and the approximate sampling stations will be laid out.

Once access and sampling reaches have been approved, the dates of the sampling event will be identified and all project members will be informed. Fish sampling will be conducted within over five days between August 25, 2003 and September 12, 2003. Sampling will be as continuous and closely-spaced as possible, preferably within one week. Fish collection will use five collection methods. Fish collection by electroshocking and netting techniques will be conducted according to the protocols in Appendix B.

Fish collection techniques will be applied at stations established in the field. Each station will be established using GPS to define the beginning and endpoint. Fish will be identified and counted by species by qualified fisheries biologists. Each station will have measurements of water quality parameters of temperature, dissolved oxygen, pH, conductivity, and turbidity. Flow will be measured either at the station or at the reference location, or both. Information describing river conditions, such as width, depth, and measures of stream velocity, will be recorded for each station. Wadeable stream techniques (backpack and barge) will also assess habitat conditions for each station.

Data collection

The Project Manager will confer with NHDES Dam Bureau to get information on dam management activities for the period beginning two weeks prior to sampling through the end of sampling. Changes in release conditions from the dams operated by NHDES will be documented for this period.

Flow data and precipitation data will be documented for the same time period. Flow data will be retrieved from the USGS 01073500 LAMPREY RIVER NEAR NEWMARKET, NH gage. Precipitation measurements will be retrieved from the USGS website USGS 01073587 EXETER RIVER AT HAIGH ROAD, NEAR BRENTWOOD, NH. This information will be documented along with the flow measurement information.

Water quality information will be retrieved from the NHDES Ambient Water Quality program. The Ambient program is scheduled to measure water quality at several locations on the Lamprey River. The project manager will coordinate with the Ambient program's manager so the Ambient monitoring occurs during the BFC sampling. Data that meets the Ambient program's criteria will be accepted by the BFC project for inclusion in the BFC report.

Data entry

NHDES staff will enter the field data into Ecological Data Application System (EDAS) (http://www.ttwater.com/Ecological_details.htm#EDAS). Data will be checked for accuracy and completeness and corrected where necessary. The data will be stored in the NHDES EDAS database. Electronic exports from the database will be made to EXCEL spreadsheets and made available to the cooperating agencies in electronic format.

The Project Manager will review the results of all collection and measurements and the documentation of conditions associated with sampling. Any changes from the methods in the SOPs will be documented in the Final Report.

Final Report

A Final Report will be written by the Project Manager that describes the sampling event, documents the fish sampling results and ancillary data for each sampling station. The results from the stations will be compiled to define a Baseline Fish Community for the Lamprey River Designated Reach in consultation with the technical advisors and field team leaders. The Baseline Fish Community will be a ranking by species abundance using the percent that each species represents of the sample. Fish collection data and other measurement data will be compiled by station for the Final Report. All fish data will also be compiled by macrohabitat type. Results by macrohabitat will be roughly analogous to compiling the results by sampling method.

Limits

This program is limited by the need to coordinate staff and equipment from NHDES, NH F&G, MA F&W, USEPA and US F&W into a weather-dependent sampling event. Access to the river for boat trailers is limited by the few road crossings and by shallow reaches. All work is being done without project-specific funds.

Schedule

This project will be conducted following as closely as possible the schedule in Table 3.

Table 3 - Project Schedule Timeline

Activity	Dates (MM/DD/YYYY)		Product	Due Date
	Anticipated Date(s) of Initiation	Anticipated Date(s) of Completion		
QAPP Preparation	05/20/2003	07/14/2003	QAPP Document	07/14/2003
Access reconnaissance	05/15/2003	06/25/2003	Access points	06/25/2003
Stream flow reference site	05/15/2003	07/03/2003	Flow measurement site	07/03/2003
Reconnaissance meeting	06/25/2003	06/25/2003	Access points approved and a map of sampling reaches for each method	07/03/2003
Dam Bureau conference	08/11/2003	09/12/2003	Documentation of dam operations	09/12/2003
Sampling and measurement events	08/25/2003	09/12/2003	Fish collection data, water quality data, flow data, habitat data	9/12/2003
Data entry and QC	09/15/2003	09/26/2003	Checked data sets in electronic format	09/26/2003
QA/QC evaluation	09/26/2003	10/10/2003	Documentation of data quality	10/10/2003
Report	07/03/2003	11/14/2003	Report compiling method descriptions and results published and distributed to cooperating agencies and NHDES website	11/14/2003

Based on EPA-NE Worksheet #10.

A7 – Quality Objectives and Criteria

The critical data in this project are the numbers and species of fish collected at each sampling station. There are no laboratory procedures proposed. Fish captured will be identified to species level by qualified biologists and the number of each species will be recorded. Precision specifications are not applicable to fish data. NHDES has no data quality objectives defined for the fish collection methods. The only critical data are the numbers and species of fish collected at each station by each method.

Information describing the water quality, the station dimensions, and the sampling method will be valuable in evaluating the results from each station. Station descriptions need to show the comparability of sampling and environmental conditions at each station. Each sampling station within a collection method may be compared using area sampled, time day sampled, duration sampled, etc.

Water quality sampling and measurements of stream dimensions, flow, and habitat conditions will further define conditions so results can be described as not being unduly influenced by these factors. Water quality measurements will be conducted under NHDES Ambient Water Quality program's protocols. Results do not need an undue level of precision or accuracy and should be adequately represented using the instruments and methods used by NHDES to conduct TMDL and Ambient Water Quality measurements. For quality assurance purposes, field duplicates and field replicates are required on at least ten percent (10%) of all water quality measurements collected or at least once daily. Duplicate measurements are made in two SEPERATELY collected sample buckets. Duplicate measurements show instrument or field variability. Replicate measurements are made from the SAME sample bucket. Replicates measure instrument variability. Tables 4 and 5 summarize the performance criteria for samples collected for this project. The quality objectives for backpacking and barge shocking are those of the NHDES Biomonitoring Program.

Field team leaders will review data sheets at least once at the end of each sampling day. Sheets will be checked for completeness, legibility, and to ensure readings and measurements are within possible ranges. All corrections and changes will be initialed and explanations noted where necessary.

Precision: Precision is the degree of agreement among repeated measurements of the same characteristic (parameter) under the same or similar conditions.

Performance specifications for the YSI 650 MDS Multi-Parameter Unit to be utilized in monitoring in-stream chemical water quality parameters are listed in Table 3 and are predetermined by the manufacturer.

Table 4 - Sensor Specifications for YSI 650 MDS for Surface Water Samples

Parameter	Sensor Type	Range	Accuracy	Resolution
pH	Glass Combination Electrode	0 - 14 units	+/- 0.2 units	0.01 Units

Conductivity	4 Electrode Cell with Auto ranging	0 to 100 mS/cm	+/- 0.5% of reading + 0.001 mS/cm	0.001 mS/cm to 0.1 mS/cm (range dependent)
Dissolved Oxygen	Rapid Pulse - Clark type, polarographic	0 to 50 mg/L	0 to 14.6 mg/L, +/- 0.2 mg/L	0.01 mg/L
Temperature	Thermistor	-5 to 45°C	+/- 0.15°C	0.011% air saturation

Performance specifications for the individual hand-held meters to be utilized in monitoring in-stream chemical water quality parameters are listed in Table 4 and are predetermined by the manufacturer.

Table 5 - Measurement Performance Criteria for Surface Water Samples using Hand Held Meters

Analytical Parameter	Analytical Method/ SOP Reference	Measurement Performance Criteria		QC Sample and/or Activity Used to Assess Measurement Performance
		Precision	Accuracy	
Temperature	B-7	+/- 1 degrees C		Field duplicates
Dissolved Oxygen	B-7	+/- 0.5 mg/L		Field duplicates
		+/- 0.5 mg/L		Measurement replicates
			± 2.0% of saturation ^a	Meter review ^b
pH	B-4	± 0.2 std units		Field duplicates
		± 0.2 std units		Measurement replicates
			± 0.2 standard units	Known buffer (pH = 6.0)
Specific Conductance	B-5	RPD ≤ 15%		Field duplicates
		RPD ≤ 15%		Measurement replicates
			± 5.0 µS/cm	Calibration standard
		RPD ≤ 15%		Field duplicates
Turbidity	B-6	RPD ≤ 15%		Measurement replicates
			± 1.0 NTU	Calibration standard
Flow	B-1	RPD ≤ 15%		Measurement replicates

^a Relative accuracy

^b meter review = replacing sensor in storage chamber and recording measurement, with subsequent comparison to initial calibration value

Where duplicate precision is analyzed by calculating the relative percent difference (RPD) acceptance evaluation will use the equation:

$$RPD = \frac{|x_1 - x_2|}{\left(\frac{x_1 + x_2}{2}\right)} \times 100\%$$

where x_1 is the original sample concentration
 x_2 is the duplicate sample concentration

Accuracy/Bias: Accuracy is the extent of the agreement between an observed value (sample result) and the true value of the parameter being measured. No laboratory methods are planned. Where applicable, field meters will be checked against a known standard as a check on accuracy and calibrated prior to each reading. See Table 4 above. YSI Multi-meters are checked by calibration before and after sampling.

Representativeness: Representativeness defines the extent to which the sampling data describes actual environmental conditions. The data quality objective for all parameters is to get as representative a sample as possible of the species diversity in all habitat types. Fish sampling will represent a snapshot in time of the fish species in the Designated Reach. Sampling will be conducted both above and below Wiswall Dam over at least 2500 feet (approximately 30 times the stream width) using backpack, barge, or boat electroshocking methods. The stream width used for this length assessment is 80 feet based on the reconnaissance made October 2002 by NHDES.

Sampling will attempt to cover habitat in proportions similar to those that exist in the Designated Reach. However, data will be collected in discrete increments that can be combined later in the appropriate proportions if necessary. The sampling will be conducted over more sampling sites and using more collection methods than in previous studies. The sampling will attempt to collect species in deep water environments that have not been sampled comprehensively prior to this survey. Sampling with the combination of all of the proposed techniques has not been done before on this river.

Comparability: Comparability refers to the extent to which the data from this study is comparable to other studies conducted in the past or from other areas. Previous sampling was conducted using backpack electroshocking, gill nets, or both. During this sampling project, we using backpack electroshocking and gill net techniques and also will use barge and boat electroshocking and shoreline seines. This project will use standardized sampling and measurement methods used by NHDES' Biomonitoring and Ambient Water Quality programs for the backpack and barge electroshocking, flow measurements and water quality assessments. For boat shocking, shoreline seining, and experimental gillnets, methods have been developed from methods used by MA DFW and NH F&G which have been revised for riverine sampling and to meet project requirements. Units of reporting will be consistent with NHDES' Biomonitoring and Ambient Water Quality programs. Station selection will be assisted by the field team leaders who are experts from the cooperating agencies in fish sampling and assessment of the ancillary information.

Involvement by staff biologists from NH F&G and NHDES who are experienced in fisheries sampling on the Lamprey, and by staff biologists from the other cooperating agencies familiar with fish collection methods, will ensure comparability for collection techniques and species identification and measurement. The results from individual sampling events in this study will be comparable to previous fisheries work; however the overall results are expected to be a more complete capture of the existing species and in larger numbers.

Sensitivity: Sensitivity is the ability of the method or instrument to detect the target at the level of interest. The water quality measurement equipment and flow meters used are the same instruments used in the Biomonitoring and Ambient Water Quality programs and meet these

programs' needs. Detectable ranges of the equipment are adequate for the purposes of this project. See Table 5. Fish sampling will use standard equipment. Use of this equipment will follow existing NHDES protocols or protocols adapted from other agencies to meet the specific project needs. These techniques have been used satisfactorily to sample fish in other studies.

Table 6 - Surface Water Quality Field Measurements and Reference Limits

Analyte	Analytical method (See Appendix B for SOPs)	Field Instrument Sensitivity
Field Measurement		
Temperature	YSI Model 52	--
Dissolved oxygen	YSI Model 52	0.1 mg/L; 0.1% saturation
Temperature	YSI Model 95	0.1 degrees C
Dissolved oxygen	YSI Model 95	0.01 mg/L; 0.1% saturation
pH	Orion Model 250A Meter and Triode Model 91-57BN Electrode	--
Specific Conductance	YSI Model 30	0.6 μ S/cm
Turbidity	Lamotte Model 2020	0.01 NTU
Temperature	Hydrolab DataSonde 4a	--
Dissolved oxygen	Hydrolab DataSonde 4a	0.2 mg/L; 0.2% saturation
pH	Hydrolab DataSonde 4a	--
Specific Conductance	Hydrolab DataSonde 4a	0.6 μ S/cm
Turbidity	Hydrolab DataSonde 4a	0.01 NTU

Table 7 - Project Quantification Limits

Analyte (Medium /Matrix)	Technical Project Quantification Limits	Analytical method ⁽¹⁾
Temperature (Water)	-5 deg C to 30 deg C	Hand meter B-7 Hydrolab B-1
Dissolved Oxygen (Water)	0.5 mg/L	Hand meter B-7 Hydrolab B-1
pH (Water)	2-12 units	Hand meter B-4 Hydrolab B-1
Conductivity (Water)	0-1000 ms/cm	Hand meter B-5 Hydrolab B-1
Turbidity (Water)	0-100 NTU	Hand meter B-6
Flow (Water)	0 – 100 cfs	Hand meter B-1

Notes: See Appendix B for Field Standard Operating Protocols.

Completeness: Completeness is a measure of the number of samples you must take to be able to use the information, compared to the number of samples you originally planned to take. Investigators will collect as many samples as time allows. Electroshock sample lengths combining to at least 30 times the average stream width (approximately 2500 feet) will be sampled by electroshocking methods both above and below the Wiswall Dam impoundment. Thirty times the average stream width was chosen as a compromise between EMAP criteria of 20 stream widths and NAQWA criteria of 40 stream widths. The sample collection effort will be considered complete if it covers at least 2500 feet (representing approximately 30 stream widths) and if wadeable or non-wadeable electroshocking methods each cumulatively captures ten or more individuals of the five most frequently occurring species. [Bain, 2002]

Backpack, barge, and boat electroshock sampling reaches will be completed in 150-meter segments. Each segment will be one sampling station. Fish from each segment of a sampling reach will be counted separately so that each sample reach represents a complete sampling event when combined with flow, water quality and habitat evaluations. Combining these individual sample events should result in collecting sufficient numbers of species and of individual fish such that additional sampling would not change the distribution of abundance of the top five fish species by more than 10 percent. Based on results of previous sampling in the Lamprey and statewide, collection of 10 or more species should be expected from the combined sample pool. Results of previous fish sampling on the Lamprey both within and without the areal limits of this project are available in Appendix C – Previous Lamprey Fish Sampling. If ten or more individuals of the five most frequently occurring species have not been captured after 30 stream widths, collecting will continue until this criterion is reached.

A8 – Special Training/Certification

No training specific to this project is proposed. Fish sampling crews will have at least one fisheries biologist from NHDES, NH F&G, US EPA or MA DFW who will act as crew leader, who is trained and experienced in standard fisheries techniques for the method being used. Other crewmembers may be interns or other agency staff who will be experienced or familiar with the sampling method and will be directed by the crew leader. At least one NHDES staff member for each field team will have been trained under the NHDES Ambient Water Quality, TMDL, or Biomonitoring program to operate the Hydrolabs, water quality meters and flow meters according to NHDES protocols.

A9 – Documents and Records

Records will include field sheets for each sampling event with fish species enumeration, water quality values, instrument calibration values, stream flow measurements, staff gage readings, location documentation, and habitat information. Records will include downloaded values from the USGS 01073500 LAMPREY RIVER NEAR NEWMARKET, NH gage, and from the USGS 01073587 EXETER RIVER AT HAIGH ROAD, NEAR BRENTWOOD, NH precipitation gage. Records of dam operational changes in the Lamprey watershed will be documented for the project. The report will draw on NHDES Ambient Water Quality program's data for the Lamprey. All data will be stored as original paper copies and as electronic data entered from the original field sheets.

The field sheets, maps and any field notes will be retained by the NHDES Biomonitoring Program, and data will be transferred to an electronic format in EDAS. Copies of blank field sheets are in Appendix D. The information recorded on these sheets will be transferred to the Ecological Data Assessment System (EDAS). The EDAS database manages chemical, physical, and biological data using a Microsoft Access platform. Entry of data into EDAS is performed through a data entry switchboard, allowing for the selection of one of several sub-forms into which data is entered. Data recording and transcription from field sheets to the database will be monitored and checked for accuracy by the EDAS Database Manager.

Sampling results will be detailed in a "Report of the Baseline Fish Community for the Lamprey Designated Reach" produced by NHDES. This document will describe the species and the percent relative abundance each species exhibits within the total fish in the respective sample pool. The report will include fish species and numbers by sampling station. Compilation of stations into groups by combined sampling method will also be included; results from netting and boat shocking techniques will be combined and results from backpack and barge shocking will be combined. The sample techniques are going to be applied to reaches such that techniques are roughly analogous to macrohabitat. These combinations will show the communities related to deep runs or to riffles and shallow runs. The relative species abundance for each combination will be reported. Differences between these communities for stations above and below Wiswall Dam will be assessed. Finally, the fish data will be combined in proportion to the distribution by length of the deep runs to riffles and shallow runs. The station lengths for deep runs will be compared to the remaining river length to establish the appropriate proportion. After applying this proportion to the two data sets, a baseline fish population defined by percent species abundance will result. Charts of species percent compositions that complement the data sets will be included. The report will also include stream characteristics such as water quality and flow conditions. Barge and backpack stations will have habitat assessments included. This report will be distributed to the cooperating agencies and made available on the NHDES website. This Quality Assurance Project Plan for the BFC sampling will be electronically stored in NHDES Watershed Management Bureau's QAPP directory and a hard copy will be retained in the Biomonitoring Program's files. Electronic and paper copies of the report and the QAPP will be kept by the Biomonitoring Section for at least five years.

B1 – Sampling Process Design

RATIONALE

Fish collection will be conducted in the towns of Durham and Lee on the Designated Reach of the Lamprey River. Collection will be done using backpack, barge and boat electroshockers, shoreline seining and gillnets. Scant fisheries data are available for the Lamprey River, but river and fisheries management organizations need this kind of data. Identification of fish species and their distribution within the Designated Reach under this project will begin to provide the needed information. Sampling will be conducted to collect fish at multiple locations and two general macrohabitat types. Sampling stations will be distributed over the Designated Reach as uniformly as time and access allow. As many sampling stations as possible will be collected.

Collection using electroshocking methods will be conducted on at least 2500 feet of the river both above and below the Wiswall Dam to ensure that enough of the river is sampled. Electrofishing will be conducted in 150-meter segments to be comparable to existing NHDES Biomonitoring data on this and other rivers. Boat shocking reaches account for approximately 60% of the Designated Reach. About half of that is in impoundments behind Wiswall Dam and the Macallen Dam. Wadeable reaches represent about 20% and reaches that are between being wadeable and being boatable represent another 20%. Electroshocking coverage will attempt to distribute the sample reaches covered at 40% wadeable shocking methods and 60% boat shocking. Netting stations for shoreline seining and gillnetting will be distributed evenly above and below Wiswall Dam and are intended to supplement the boat shocking data. The netting stations are not part of the percentage calculation, but augment the results of the boat shocking. A minimum of six electroshocking stations will be sampled both above and below Wiswall dam. Shoreline seining and gillnet sets should be separate stations from the boat shocking reaches, but should match and complement them.

Rationale for numbers and location of fish collection stations

Reconnaissance of the river June 25, 2003 identified reaches that were suitable for sampling using the methods chosen. Potential for access was also identified that excluded some reaches from further consideration. Boat shocking stations within the potentially accessible reaches were distributed uniformly based on the lengths of the reach and the number of stations judged to be possible with the time and resources available. Shoreline seine and/or gillnet stations were assigned to each boat shocking station and to reaches that were suitable, but inaccessible, for boat shocking. Reaches that were wadeable were assigned either barge or backpack shocking stations. Barge stations were assigned wherever depth and access favored its use and backpack shocking was assigned where access was difficult for introducing the barge or potentially shallow sections would restrict barge movement. Again stations were distributed uniformly among accessible reaches based on the length of all suitable reaches. Numbers of wadeable stations were based on the approximately 60:40 length distribution between deep and wadeable or marginal reaches as determined from the October 2002 reconnaissance. There are 17 proposed boat shocking sites and 12 proposed wadeable shocking sites so that this ratio is maintained if all stations are completed.

The Baseline Fish Community report requires only that representative sampling of fish occur. The more stations measured the better. Water quality data, flow and habitat information are supporting information to help interpret the results. Water quality data and other information about habitat and river conditions will be collected. These data will assist in ensuring that fish collection results are applied appropriately to management decisions.

Sampling in the late August through early September will meet NHDES Biomonitoring protocols for fish sampling. An ideal sampling event will be during normal flow conditions for the time period. The drought conditions that have persisted over the last two years need to be acknowledged when using and reporting these data. Sampling will be avoided during dangerous conditions such as thunderstorms, floods, etc.

TYPES AND NUMBERS OF SAMPLES REQUIRED

Fish collecting will be in five suites:

- A) Backpack Electrofishing: Backpack electroshockers will be used in wadeable reaches representing shallow stream macrohabitats less than two feet deep including riffles, shallow runs and pools. Backpack shockers may also be used in intermediate depth reaches where access for barge electroshockers is difficult. Selected segments of the wadeable portions of the river in units of 150 meters will be sampled using NHDES Biomonitoring methods for electrofishing to determine species type and numbers. The total number of sampling stations will depend on time available for sampling. Each station will have temperature, dissolved oxygen, conductivity, pH, turbidity and flow measurements collected. The project goal is to collect fish at 5 wadeable stations using this method.
- B) Barge Electrofishing: Collection will be conducted at different stations than the backpack electrofishing, but methods will be identical and results should be comparable. The barge electroshocker can collect fish from waters slightly deeper than the backpack shockers can. Barge shocking can be used in water approaching four feet because the power unit is not carried on a wader's back but is mounted on a small boat. Backpack shockers will be used in shallow to intermediate-depth reaches wherever stream conditions and access allow. Anywhere there is more than a foot of water the barge can be floated easily with the shocking crews. Selected segments of the wadeable portions of the river in units of 150 meters will be sampled. The total number of sampling stations will depend on time available for sampling. Each station will have temperature, dissolved oxygen, conductivity, pH, turbidity and flow measurements collected. The project goal is to collect fish at 7 wadeable and marginal stations using this method.
- C) Boat Electrofishing: Boat electrofishing will be used to sample fish in the deeper runs in units of 150 meters with multiple passes. Sampling time will be tracked also and limited to 1000 seconds. The deep runs are generally greater than four feet deep, but may have short intervals of slightly shallower water. The total number of sampling stations will depend on time available for sampling. Each station will have temperature, dissolved oxygen, conductivity, pH and turbidity measurements collected. Depth, width and velocity measurements will be made. The project goal is to collect fish at 17 stations using this method.
- D) Gillnetting: Experimental mesh gillnets will be used to sample the fish community structure in the deep water areas of the river that cannot be effectively fished by the boat shocker nor reached by wading techniques. The total number of sampling stations will depend on time available for sampling. Each station will have temperature, dissolved oxygen, conductivity, pH and turbidity measurements collected. Depth, width and velocity measurements will be made. The project goal is to collect fish at 24 stations using this method.
- E) Shoreline Seining: Shoreline seining will sample young of the year and species found in shallow areas of these deeper runs not susceptible to either boat electrofishing or gillnetting. The total number of sampling stations will depend on time available for sampling. Each station will have temperature, dissolved oxygen, conductivity, pH and turbidity measurements collected. Depth, width and velocity measurements will be made. The project goal is to collect fish at 24 stations using this method.

Table 3: Sampling Stations and Parameters

Station ID	Reach	Description	Fish Collection Method	Water Quality Measurement Method	Flow	Habitat Assessment
03P-101	B		Backpack shocking	Hydrolab and turbidity meter	Station specific flow	RBP sheets
03P-102	C					
03P-103	C					
03P-104	D					
03P-105	E					
03P-111	A		Barge shocking	Hydrolab and turbidity meter	Station specific flow	RBP sheets
03P-112	B					
03P-113	B					
03P-114	B					
03P-115	B					
03P-116	B					
03P-117	B					
03P-121	A		Boat shocking	Field meters ^a	Daily reference location measurement	Width and depth cross-sections
03P-122	A					
03P-123	B					

Station ID	Reach	Description	Fish Collection Method	Water Quality Measurement Method	Flow	Habitat Assessment
03P-124	B					
03P-125	B					
03P-126	B					
03P-127	B					
03P-128	C					
03P-129	C					
03P-130	C					
03P-131	C					
03P-132	C					
03P-133	E					
03P-134	E					
03P-135	E					
03P-136	E					
03P-137	E					
03P-151	A		Gillnet and / or shoreline seine netting	Field meters ^a	Daily reference location measurement	Width and depth cross
03P-152	A					
03P-153	A					
03P-154	B					
03P-155	B					
03P-156	B					

Station ID	Reach	Description	Fish Collection Method	Water Quality Measurement Method	Flow	Habitat Assessment
03P-157	B					
03P-158	B					
03P-159	B					
03P-160	B					
03P-161	B					
03P-162	C					
03P-163	C					
03P-164	C					
03P-165	C					
03P-166	C					
03P-167	D					
03P-168	D					
03P-169	D					
03P-170	D					
03P-171	E					
03P-172	E					
03P-173	E					
03P-174	E					
03P-175	E					

^a Field meters are DO/temp. meter, pH meter, conductivity meter and turbidity meter.

^b Reach A – Start of Designated Reach to Wadley Falls

Reach B – Wadley Falls to Lee Hook Road

Reach C – Lee Hook Road to Wiswall Dam

Reach D – Wiswall Dam to Packers Falls
Reach E – Packers Falls to end of Designated Reach

Water quality and flow measurements will be made to support the fish data. Water quality measurements will be collected at each fish collection station prior to sampling. Flow will be collected at each backpack or barge sampling station. At the netting stations and boat shocking stations, flow will be recorded from the reference flow station measured daily or the Lamprey River gage, or both. Table 8 shows the water quality parameters to be taken. Replicate and duplicate measurements should be taken early each day to confirm measurements.

THE DESIGN OF THE SAMPLING NETWORK

The sampling reaches will be from the beginning of the Designated Reach where the Lamprey crosses the Epping-Lee boundary downstream to the end of the Designated Reach where the Lamprey crosses the Durham-Newmarket boundary. Fish sampling will be done on as much of the river as possible and distributed as evenly as possible within the Designated Reach. This Plan proposes a distribution of sampling stations in the shallow/intermediate depth habitats and the deep runs in proportion to the lengths of these habitats as defined by NHDES following the October 2002 reconnaissance and revised. Fish samples will be collected in late August through early September of 2003 and within no longer than a two week period.

Shallow, wadeable reaches will be sampled with backpack or barge electroshocking units. Intermediate depth reaches may be suitable for barge electroshocking in some locations. The intermediate depth reaches represent segments too deep for backpack wading, but too shallow for boat electroshockers. In some cases depth conditions change markedly from one side of the river to the other making neither boat shocking nor backpack shocking entirely suitable. Deep reaches are suitable for boat electroshocking under most flow conditions. There are two deep reach created artificially by Wiswall Dam and Macallen Dam. These are similar to other deep run segments except they are caused by artificial impoundments. All four types of reaches have been mapped for the Designated Reach during the October 2002 reconnaissance. See Map in Appendix A.

Sampling method was selected by identifying the macrohabitat approximated by the depth on the map in Appendix A. Sampling of shallow and intermediate depth reaches will be done with backpack and barge electroshockers selected from reaches where access is available. Selected deep and deep/artificially impounded reaches will be sampled where accessible with boat electroshockers, gill nets and shoreline seines.

FREQUENCY OF SAMPLING AT EACH LOCATION

This project will collect fish once at each station. The stations will be marked using a GPS unit and may be sampled later to assess changes in the fish community over time.

MATRICES OR MEDIA TO BE SAMPLED AND PARAMETERS OF INTEREST

Samples will be collections of fish which will be counted and identified by species, and then released. Water quality parameters of temperature (in degrees C), dissolved oxygen (in mg/L and percent saturation), pH (in pH units), conductivity (in mS/cm²), and turbidity (in NTUs) will be measured once at each sampling location. Duplicate measurements will be made once every ten

readings or at least once per day. Flow will be measured once at every backpack or barge shocking reach. Flow will be calculated by measuring water velocity and stream cross-sectional dimensions. At least once a day a flow measurement will be made at the reference streamflow measurement site, or a calibrated staff gage will be read at the beginning and end of each sampling day. Habitat assessment conducted at backpack and barge electrofishing stations will look at riparian and stream conditions such as microhabitat variety, erosion, and canopy cover. (See Appendix B-1, Section 5.)

Table 8 - Data Collection Design

Datum Type	Measure	Sampling Frequency	Where Performed
Water	Dissolved oxygen, pH, Conductivity, Temperature, Turbidity	Once per sampling station	Beginning of electroshocking reach and the center of each netting location.
Water	Flow	Station specific measurement at each backpack/barge shocking reach	At sampling station
Water	Flow	At minimum daily flow measurements at a reference station above Wiswall Dam	Reference flow site
Fish	Collection	Once per sampling station	Each sampling station above or below Wiswall Dam
Habitat	Habitat Assessment of In-stream and Riparian Habitat from Rapid Bioassessment Protocol (Appendix D)	Once per backpack/barge station	Each 150 meter reach where backpack or barge electroshocking is conducted

EXPECTED CONCENTRATION LEVEL OF EACH PARAMETER

Results of earlier fish sampling by NH F&G and by NHDES can be found in Appendix C. Species collected during this project are expected to be similar. See Table 2 in Section A5 for expected water quality parameter values.

B2 – Sampling Methods

Several methods of fish collection and two methods of water quality measurements will be used. The sample methods are determined by river conditions. The water quality measurements are consistent with NHDES protocols for biomonitoring or ambient river sampling. All methods are described below and in greater detail in Appendix B.

GPS measurements will be made at the endpoints of the electroshocking reaches. See Appendix B-2 GPS Standard Operating Procedures. Separate GPS measurements will be made where water quality measurements are made if they are not made at the beginning or end of the fish collection reach. GPS readings for the netting techniques will be centered on the sampling location.

FISH COLLECTION

Backpack Electrofishing

The project will follow the NHDES fish assessment protocol. For complete procedures, see Appendix B-1, Section 4. The NHDES fish assessment protocol is adapted from the United States Environmental Protection Agency's Rapid Bioassessment Protocol 8 [Plafkin et al., 1999]. The methodology is designed for wadeable streams and rivers, and uses backpack electrofishing equipment.

Backpack electrofishing surveys in the Biomonitoring program are typically conducted from the beginning of June through the end of September. All dominant habitat types within the reach are sampled. This includes pools, riffles, and runs as well as other types of habitat that may be present. Each station will cover a sampling distance of 150 meters. Stations will be selected in the field to include representative numbers of riffles, runs, pools and meanders. Once a stream segment is selected, electrofishing collects fish in a single pass over the reach.

Four people are involved in the in-stream shocking process; one individual operating the backpack shocker, two people netting the stunned fish, and the fourth person carrying an aerated holding tank to retain the fish. Sampling takes place in an upstream direction, eliminating problems of turbidity introduced from the survey crew while maximizing the capture of immobilized fish that are drifting downstream. All possible precautions are taken to avoid fish mortality. Fish are removed from the electric field as soon as possible. The level of effort at each sampling station is measured by actual shock time, and sampling is standardized over the 150 meter length of stream.

When electrofishing is completed for a reach, the number of organisms of each species is recorded. Young of the year (YOY) are recorded for non-forage species, but not included in data enumeration. This consists of fish less than 25 mm in length. Adult fish (and/or those >25 mm) are inspected for external anomalies and noted, and then they are returned to the waterbody.

Barge Electroshocking

Barge Electroshocking will be conducted using the same operational methods as used for backpack shocking. Barge electroshocking uses a generator mounted on a small boat instead of backpack-mounted units. The shocking team is not dependent on batteries and may access deeper waters thus unencumbered. This collection method will assess shallow and intermediate depth (up to 4 feet) sections of the river. The shocking team wades in an upstream direction with one member assigned to push the boat. Up to three operators manage the shockers while two people for each shocker net fish, and a fourth person carries an aerated holding tank to retain the fish. It is also conducted from downstream to upstream and collects fish in a single pass over the reach.. The barge sampling will include the same water quality measurements, habitat assessment, and flow measurements as backpack shocking teams use. For complete procedures, see Appendix B-1, Section 4.

Boat Electroshocking

Boat electroshocking uses a larger version of the barge electroshocking unit on a motorized boat that the shocking team stands in. The 3-person shocking team rides in the boat. One person operates the boat and electroshocking unit, while two people scoop up fish with nets. Sampling is conducted by making multiple passes upstream and downstream to cover as much of the 150

sampling reach as possible. The boat covers the margins before shocking in the center of the reach. This collection method assesses the top of the water column in deeper sections of the river. Sampling will be considered complete after 1000 seconds of sampling. Then the fish that are captured will be identified and released. For complete boat electroshocking procedures, see Appendix B-9 Draft NHDES Boat Electroshocking Protocol [July 15, 2003]. [NH Boat Electrofishing Standard Operating Procedure.doc](#)

Experimental Gillnetting

Gillnets use several nets with variable mesh sizes used for experimental capture of fish of different sizes. This collection method assesses deeper sections of the river not easily accessible by boat shocking or shoreline seining. Standard monofilament experimental gillnets 1.8 m deep x 45.7 m long, with mesh sizes (stretch) ranging from 38 mm to 102 mm will be set perpendicular to shore at a maximum depth of just above any anoxic layer (as determined by the Hydrolab). Nets are placed vertically in the water with one edge weighted and the other held up with floats. The nets are left for a standard period and then retrieved. This passive fishing method results in different capture effectiveness from active electrofishing methods, and is dependent on fishing density for capture efficiency. Gillnetting is stressful to fish and will not be conducted overnight. Surviving fish will be released. For complete gillnetting procedures, see Appendix B-10 Draft NHDES Gillnetting Protocol [July 15, 2003]. [NH Biomon Gillnetting Standard Operating Procedure.doc](#)

Shoreline Seining

Shoreline seining is an active fishing technique using single mesh-sized nets with one weighted edge and one floating edge. This collection method will assess shallow edges of (less than 2 feet) sections of the river. A seine with a center bag will be used to sample via a fixed pole technique. The net is deployed by anchoring one end near shore. The running end is extended into the stream by wading or with a boat. The running end is then brought upstream and then to shore. Both ends are then retrieved to capture the fish. By this method, approximately 180 m² will be sampled.

Sites with firm substrate, moderate to sparse vegetation and a bottom slope of 1:10 or less will be preferred as seining stations. Sampling is usually conducted during September because YOY fish are universally large enough to be captured by then and much of the early mortality has occurred so the population is stable and the sample is not overwhelmed with YOY. For complete shoreline seining procedures, see Appendix B-8 Draft NHDES Shoreline Seining Protocol [July 15, 2003]. [NH Shoreline Seining Standard Operating Procedure.doc](#)

WATER ANALYSIS

Water Analysis for Barge and Backpack Stations

On-site chemical analysis for backpack and barge stations will be performed using a HYDROLAB Multi-Parameter Data Sonde 3 logger, which measures conductivity, dissolved oxygen, pH, and temperature. For complete procedures see Appendix B-1, Section 6. Turbidity measurements have been added to the standard sampling package for this project.

Water Analysis for Boat Electroshocking and Netting Stations

Water quality measurements for the boat electroshocking teams and netting team will follow NHDES Ambient River program equipment, collection and measurement protocols. Analysis is

performed using field meters which measure conductivity, dissolved oxygen and temperature, pH, and turbidity. Samples are collected using a 5-gallon pail and the measurements are taken immediately from the bucket. Duplicate and replicate readings should be taken once for every ten measurements or at least once daily. For complete procedures see Appendix B-3 through B-7.

HABITAT ASSESSMENTS

Assessments of the riparian and in-stream habitat will be carried out by trained field personnel. For complete procedures, see Appendix B-1, Section 5. The Biomonitoring Program has incorporated EPA's habitat assessment protocol, which focuses on the physical characteristics of a particular station encompassing a 150m reach. Stream flow and additional station information are recorded at each station.

FLOW MEASUREMENTS

Flow measurements will be made at each sampling station by measuring stream velocities and depth using a Marsh-McBirney Model 2000 Flow-Mate Velocity Meter, and the width of the stream. For complete procedures, see Appendix B-1, Section 5.

Table 5. Sample Requirements

Analytical parameter	Collection method	Sampling SOP	Sample volume	Container size and type
Fish	Backpack Electroshocker	B-1	NA	NA
Fish	Barge Electroshocker	B-1	NA	NA
Fish	Boat Electroshocker	B-9	NA	NA
Fish	Shoreline Seine	B-8	NA	NA
Fish	Experimental Gillnet	B-10	NA	NA
Temperature	Measured in-situ for BP/Barge	B-1	NA	NA
Dissolved oxygen and Temperature	Measured from a bucket for other fish collection methods	B-7	3-5 gallons	5-gallon bucket
pH	measured in-situ	B-1	NA	NA
pH	Measured from a bucket for other fish collection methods		3-5 gallons	5-gallon bucket
Dissolved oxygen	measured in-situ	B-1	NA	NA
Conductivity	measured in-situ	B-1	NA	NA
Conductivity	Measured from a bucket for other fish collection methods	B-5	3-5 gallons	5-gallon bucket
Turbidity	Grab sample	B-6		NA
Flow	Flow meter	B-1	NA	NA
Flow	Reading from calibrated staff gage	NA	NA	NA

EQUIPMENT FAILURE

Field Team Leaders will be responsible for notifying the Project Manager if a failure in the fish collection or water quality measurement occurs. The Project Manager will assist in correcting the failure or replacing malfunctioning equipment. The Field Team Leader is responsible for corrective action, which will be documented on field data sheets. Corrective action for water quality measurements is prescribed as following. If a meter is found to be malfunctioning and recalibration does not correct the problem, a replacement meter will be used for that day or the following days. If a replacement is not available, no data will be collected. If fishing gear is found

to be defective it will be replaced or repaired. Field team leaders will document on the field sheets any equipment failure and the corrective action taken, if any.

B3 – Sample Handling and Custody

Water quality measurements will be made in-situ by the backpack and barge teams and require no sample handling or custody. Water quality measurements made by the boat and netting teams will be collected in 5-gallon pails used by NHDES especially for this purpose. The NHDES Biomonitoring Program does not have a protocol for voucher collection for fish species. The procedure for this project will be to retain representative specimens only from taxa that are unclear or in question. These fish will be put in ethanol and retained by the NHDES Biomonitoring Section or photographed as whole fish with additional close-up photographs of diagnostic features for later verification. Fish voucher samples, when required, will be saved only until a positive identification is made or the project report is final, whichever is later.

B4 – Analytical Methods

There are no laboratory analyses proposed for this project. Table 9 lists the field measurements that will be made and the equipment required. If there is equipment failure, the sampling team leader will notify the Project Manager and a meter will be borrowed from one of the other teams in the field or from a reserve of spare meters, if available.

Table 9 - List of field analytical equipment required

FIELD ANALYSIS	Name of Instrument:
<u>At backpack or barge stations:</u> Temperature Dissolved oxygen pH Specific Conductivity Turbidity	YSI 650 MDS Multi-Parameter Unit YSI 650 MDS Multi-Parameter Unit YSI 650 MDS Multi-Parameter Unit YSI 650 MDS Multi-Parameter Unit LaMotte Model 2020 or YSI 650 MDS Multi-Parameter Unit
<u>At other than backpack or barge stations:</u> Temperature Dissolved oxygen pH Specific Conductivity Turbidity	YSI 52 Meter or YSI 95 Meter YSI 52 Meter or YSI 95 Meter Orion 210A Meter YSI 30M Meter LaMotte Model 2020
Stream flow	Marsh-McBirney Model 2000 Flow-Mate Velocity Meter Staff gage established by Town of Durham near Lee Hook Road
Location	Garmin GPS or Trimble GPS

B5 – Quality Control

Fish Collection Quality Control

Quality control for each fish sampling method will rely on standardized application of these methods. Documentation of the actual sampling activities conducted will describe how close to the standard each collection effort remained. Identification of species will be made by qualified fisheries biologists experienced with the species expected to be encountered. Should there be a question about a species identity a voucher sample will be collected and the identity will be determined by consensus of the project team leaders and technical advisers.

Water Quality Field Measurement Quality Control

Field duplicate measurements and replicate measurements are made with field meters for all field parameters at least once in ten measurements or at least once a day. Turbidity and specific conductance measurements are verified through comparisons with field blanks, whereas pH measurements are verified using a known buffer (e.g., pH = 6.0). Dissolved oxygen measurements are verified by comparing the percent of saturation value prior to the sample with the percent of saturation after the sample. Hydrolabs will be checked by calibration at the beginning and end of each day's use.

Duplicate and replicate data will be assessed for the water quality measurements and data that does not meet the quality objectives will be flagged. Field sheets will be reviewed for calibration and maintenance problems. Data will be flagged if it was collected using field equipment that was not properly calibrated or maintained.

Table 10 - Field Analytical QC Sample Table.

Water Quality Parameter	QC Check ^a	QC Acceptance Limit	Corrective Action	Person Responsible for Corrective Action	Data Quality Indicator
Temperature	Field duplicate; Measurement replicate	$\pm 0.2^{\circ}\text{C}$	Repeat measurement	NHDES WQ measurement-trained staff member	Precision
Dissolved Oxygen	Field duplicate; Measurement replicate	$\pm 2\%$ of saturation, or $\pm 0.2\text{ mg/l}$	Recalibrate instrument, repeat measurement	NHDES WQ measurement-trained staff member	Precision
	Instrument blank ^b	$\pm 2\%$ of saturation, or $\pm 0.2\text{ mg/l}$	Recalibrate instrument, repeat measurement	NHDES WQ measurement-trained staff member	Relative accuracy
pH	Field duplicate; measurement replicate	± 0.1 std units	Recalibrate instrument, repeat measurement	NHDES WQ measurement-trained staff member	Precision
	Known buffer (pH = 6.0)	± 0.1 standard units	Recalibrate instrument repeat measurement	NHDES WQ measurement-trained staff member	Accuracy
Specific Conductance	Field duplicate; measurement replicate	$\pm 30\text{ }\mu\text{S/cm}$	Recalibrate instrument, repeat measurement	NHDES WQ measurement-trained staff member	Precision
	Method blank	$\pm 5.0\text{ }\mu\text{S/cm}$	Recalibrate instrument, repeat measurement	NHDES WQ measurement-trained staff member	Accuracy
Turbidity	Field duplicate; measurement replicate	$\pm 0.1\text{ NTU}$	Recalibrate instrument, repeat measurement	NHDES WQ measurement-trained staff member	Precision

	Method blank	± 0.1 NTU	Recalibrate instrument, repeat measurement	NHDES WQ measurement-trained staff member	Accuracy
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^aperformed on a frequency of one per sampling day per parameter, or every tenth sample for each parameter, whichever is first

^binstrument blank = replacing sensor in storage chamber and recording measurement, with subsequent comparison to initial calibration value

Field Measurements (hand meters)

For field measurements using any of the hand-held meters (dissolved oxygen/temperature, pH, conductivity, flow), duplicate analyses will be performed on 10% of all samples (i.e., every tenth sample is a duplicate). If the two readings are off by more than 10%, the field personnel will discuss the procedures with the Project Manager until an understanding is reached. The measurement may be discarded or one kept depending on the result of the conversation. The Dissolved Oxygen and the pH meters will be calibrated prior to each sample being tested and the 100% saturation storage chamber will be checked after every sample reading.

Field meter agreement checks or group checks on all the meters used in the sampling round will be checked prior to the sampling and again at the end of the sampling. For each set of field meters, the meters will be calibrated, the probes will be placed in the same sample bucket, sample readings will be recorded and, for DO/Temp and pH meters, a known standard shall be read and all information recorded on the Field Meter Agreement Worksheet.

Field Measurements (YSI Model 30Hydrolab)

The YSI Model 30 arrives calibrated from the factory. The factory calibration is verified (meter accuracy) by using a 200 uS/cm standard according to the SOP in Appendix B-5. One replicate sample is run every tenth sample. It is taken from the same spot and immediately after taking the original sample. See Appendix B for Hydrolab SOPs

Flow Measurements

Calibration check is made by taking a reading in bucket of still water. Repeat depth and velocity readings will be taken at least once in ten measurements. See Appendix B for flow measurement SOPs.

Habitat Assessments

Habitat assessments are subjective evaluations of conditions in the fish collection reach. Crew members individually evaluate the conditions and select a score within the given range.

Variability is minimized by each member reporting their scores followed by group consensus of the final answer that will be reported. See Appendix B-1 for SOPs.

B6 – Instrument/Equipment Testing, Inspection, Maintenance

Table 11 shows the procedures and documentation activities that will be performed to ensure that all field analytical instrumentation and equipment are available and in working order when needed. See Appendix B-1 for Hydrolab SOPs and flow measurement SOPs.

Table 11 - Field Analytical Equipment Maintenance, Testing, and Inspection

Equipment name	Activity	Frequency of activity	Acceptance criteria	Corrective action	Person responsible
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Temperature / Dissolved Oxygen meter	Change battery if low, Inspect and change membrane if needed.	Prior to each use	Proper calibration	Send back to company	Field Coordinator
pH meter	Change battery if low.	Prior to each use	Proper calibration	Send back to company	Field Coordinator
Conductivity meter	Change battery if low	Prior to each use	Proper calibration	Send back to company	Field Coordinator
Hydrolab Multi-probe meter	Change battery if low, Inspect and change membrane if needed	Prior to each use	Proper calibration	Send back to company	Field Coordinator
Flow meter	Change battery if low	Prior to each use	Proper calibration	Send back to company	Field Coordinator

B7 – Instrument/Equipment Calibration and Frequency

Information regarding calibration of field analytical equipment is provided in the SOPs in Appendix B and in Table 12.

Table 12 - Field analytical equipment calibration table

Equipment name	Procedure and SOP Reference	Frequency of calibration	Acceptance criteria	Corrective action	Person responsible
YSI Model 52: Temperature / Dissolved Oxygen Meter	B-7	Before each use	+/- 0.2mg/L or +/- 2% of saturation, whichever is greater	Check battery, Wet sponge, Check for bubbles Recalibrate	NHDES WQ measurement-trained team members
Orion Model 210A Meter and Triode Model 91-57BN Electrode: pH	B-4	Before each use	Slope value 92%-102%	Check battery, Replenish electrode filling solution if necessary, Clean electrode Recalibrate	NHDES WQ measurement-trained team members
YSI Model 30: Conductivity Meter	B-5	Before each use	N/A*	Check battery, Clean electrode, Recalibrate	NHDES WQ measurement-trained team members
LaMotte Model 2020Turbidity Meter	B-6	Before each use	Match with calibration standard	Check battery, Wipe standard bottle, Recalibrate	NHDES WQ measurement-trained team members

Equipment name	Procedure and SOP Reference	Frequency of calibration	Acceptance criteria	Corrective action	Person responsible
Hydrolab Multi-probe Meter	B-1	Before each use	pH +/- 0.2 units DO +/- 0.2 mg/l Conductivity +/- 1% change Temperature +/- 0.10 degrees C	Check battery, Recalibrate, Send meter back if it won't calibrate	NHDES WQ measurement-trained team members
Marsh-McBirney Flo-Mate 2000: Stream Flow Meter	B-1	Before each use	<0.05 cfs in standing water	Check battery Recalibrate Send meter back if it won't calibrate	NHDES WQ measurement-trained team members

B8 – Inspection/Acceptance Requirements for Supplies and Consumables

All necessary supplies are already acquired by NHDES and are in ample abundance for the requirements of this study. All equipment is maintained before and immediately following each use to assure availability upon need. The field coordinator will be responsible for inspection and maintenance of supplies for field analytical equipment.

B9 – Non-direct Measurements

Documentation of flow data for the period two weeks prior to sampling until the final day of field sampling will be collected from the USGS website for USGS 01073500 LAMPREY RIVER NEAR NEWMARKET, NH gage at <http://waterdata.usgs.gov/nh/nwis/uv/?01073500>. All data will be used as reported from the web in its provisional status. The flow conditions for the sampling period will be compared to average flow conditions in the river. The final report will compare flow measurements made at the reference flow site or at sampling locations to flow conditions at the gage.

Documentation of precipitation data for the period two weeks prior to sampling until the final day of field sampling will be collected from the USGS website for USGS 01073587 EXETER RIVER AT HAIGH ROAD, NEAR BRENTWOOD, NH gage at http://waterdata.usgs.gov/nh/nwis/uv/?site_no=01073587&PARAMeter_cd=00045. All data will be used as reported from the web in its provisional status.

Documentation of NHDES Ambient River Water Quality program data collected on the Lamprey River coincident with this project will be incorporated for comparison purposes with data collected during the project. If there is NHDES Volunteer Rivers Assessment Program data collected this summer, it will be included for comparison purposes also.

Table 13 - Non-Direct Measurements Criteria and Limitations Table

Non-direct measurement (secondary data)	Data source, report date, data generator, data collection dates	How data will be used	Limitations on data use
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Streamflow in cfs	USGS 01073500 Lamprey River Near Newmarket, NH	For comparison purposes	Provisional data subject to revision
Precipitation	Exeter River At Haigh Road, Near Brentwood, NH	For reference purpose	Provisional data subject to revision
Dam management records	NHDES Dam Bureau records	For reference purpose	May have timely data for NHDES-controlled dams only
NHDES Lamprey River VRAP data	NHDES Volunteer Rivers Assessment Program	For reference purpose	Primarily summer data
NHDES Rivers Ambient Monitoring Data	NHDES Rivers Ambient Monitoring Program	For comparison purposes	Primarily summer data

B10 – Data Management

Water quality and other measurements and fish species counts will be made and then recorded on the field sheets (See Appendix D). Appropriate field sheets for sampling activities will be distributed to the project team leaders by the project manager. Station identification numbers follow NHDES Biomonitoring program's format. Station IDs will be prefixed by "03P-" indicating the year and major watershed. Each station will then be numbered sequentially by the collection method using a reserved numbering scheme (example – the first backpack station will be "03P-101"). The following range of values has been set aside for each method:

101-110	Backpack stations
111-120	Barge stations
121-150	Boat stations
151-180	Gillnet stations or shoreline seine stations

At the end of sampling at each station, the field team leaders will ensure that all necessary data sheets have been filled in completely for the sampling event. The field team leaders will submit the completed field sheets daily to the project manager. Where information on the field sheets is needed for reference in the field on subsequent days, copies will be made and distributed. All data during the project will be in the custody of the project manager, who will make sure that all hard copies and electronic copies are stored in an organized fashion. The completed field sheets will be filed and maintained by the NHDES Biomonitoring Section at the NHDES office in Concord, NH.

Table 14 - Sampling Team Field Sheet List

Sampling Team	Field sheets (Attached in Appendix D)
Backpack Shocking Team or Barge Shocking Team	Field Meter Calibration/Meter Agreement Field Sheet NHDES Ambient River Monitoring Program Equipment Checklist WQ database station forms Fish Collection Sheet Water Quality Field Data Sheet Equipment Checklist – Standard Field Sampling Flow by Velocity Meter Field Worksheet Habitat Assessment Field Data Sheet (H, M, and L Gradients)
Boat shocking Team	Field Meter Calibration/Meter Agreement Field Sheet

or Gillnet and Shoreline Seining Team	NHDES Ambient River Monitoring Program Equipment Checklist WQ database station form NHD Fish Collection Sheet Water Quality Field Data Sheet
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Data entry

Quality assurance and quality control of data entry will be performed on all data for the project. After NHDES EDAS Manager enters the project data into EDAS from the field sheets, data will be reviewed by someone other than the person who entered the data. Water quality data for each sampling station will also be entered into the NHDES Watershed Management Bureau's Water Quality database. The date of data entry and data QC will be documented on the raw data sheets in red ink and initialed by the person performing the activity. Errors such as duplications, omissions, erroneous results, etc. will be documented and reported to the Project Manager, who will then take corrective actions.

All data will be stored indefinitely by NHDES. Archived information and reports such as raw data, analysis and results, the final report and this QAPP will be packaged by the project manager. Electronic copies will be stored on the NHDES Watershed Management Bureau computer drive. All data are public information and need not be secured.

C1 – Assessments and Response Actions

Each team leader will be responsible for conducting sampling according to standard methods or for documenting variations from the method. NHDES staff assigned to each collection method will be responsible for measurements of water quality or flow, or both according to NHDES protocols. These staff members will also be required to document any variations from standard methods. Variation in method should be discussed with the Project Manager and QA/QC Officer as soon as possible.

Review of field sheets will be conducted daily for completeness, legibility and appropriate units by the Project Manager and the Sampling Team leaders. Missing information will be added when available or the space will be struck through and initialed. Illegible information will be struck through once and rewritten, then initialed by the reviewer and the collector. Where incorrect units were recorded, the units will be corrected. Where values were collected and recorded in units different from those in the plan, the values will be highlighted and notified explaining the situation.

In order to determine that field water quality analysis is occurring as planned, field staff shall meet, after the first sampling event, to discuss the methods being employed and to review the quality assurance samples. At this time, all concerns regarding the sampling protocols and analysis techniques shall be addressed and any changes deemed necessary shall be made to ensure consistency and quality of subsequent sampling.

The Project Manager will review each project teams' field sheets daily and will discuss variations from standard methods with the field team leader or NHDES staff member to get a clear picture of

the circumstances leading to variation in the method. Corrective actions may include replacement of malfunctioning equipment or an agreement to establish a new method for the remainder of the sampling program. Acceptance criteria have been discussed above. If new methods are required and established, these shall be documented and agreed on by the Project Manager, the field team leader or NHDES staff member as soon as possible.

C2 – Reports to Management

There will be one final report following the sampling. The Report will be distributed to all of the cooperating agencies in paper and electronic formats. The report will be written by the Project Manager. Recipients may use the data for their own purposes. NHDES will incorporate the data into the Lamprey Protected Instream Flow study.

D1 – Data Review, Verification and Validation

The Project Manager will review all water quality parameter and flow measurement results. The Project Manager will also review all geographic and fish sampling results, habitat assessments and location coordinates. Data entry, calculation formulas and results will be independently reviewed by NHDES staff. The Project Manager will evaluate QC requirements for usability in obtaining the stated objectives of the project based on the criteria established in Section A7 and the QC criteria in Section B5.

D2 – Verification and Validation Procedures

Field data are submitted to the Project Manager. The Project Manager reviews all field data for completeness by making sure all entries on the data sheets are filled out. The Project manager makes sure that any questionable entries are verified by speaking to the sampling team or reviewing the field logbooks, and noting any unusual or anomalous data in the project files. Any decisions made regarding the usability of the data will be left to the Project Manager; however the Project Manager may consult with project personnel, NHDES QA staff, or with personnel from EPA-NE.

D3 – Reconciliation with User Requirements.

Data will be reviewed with respect to the sampling design. Differences from the protocol will be identified in the final report. If the project objectives from Section A7 are met, the user requirements have been met. Data that has not met project data quality objectives will be identified in the final report.

References

United States Environmental Protection Agency (Plafkin et al.) Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, 2nd Edition. Washington: USEPA Office of Water (EPA 841/B99/002), July 1999.

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Defining a Target Fish Community for Planning and Evaluating Enhancement of the Quinebaug River in Massachusetts and Connecticut, Mark B. Bain and Marcia S. Meixler, New York Cooperative Fish and Wildlife Research Unit, Fernow Hall - Cornell University, Ithaca, New York 14853-3001

Mark Bain, Notes on May 31, 2002 meeting on Target Fish Community.

Scott Decker, NH Fish & Game, Provided unpublished fish survey data on the Lamprey River for 1983-1985.

NHDES Biomonitoring Section fish data for 1998

http://www.des.state.nh.us/wmb/biomonitoring/fish_assess.htm#data

Ted Walsh, NHDES VRA Program, provided water quality data from the LAMPREY RIVER VRAP 2002 REPORT, NHDES.